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THE LAKES-TO-THE-GULF DEEP WATERWAY. I

During the past six years much attention has been given to the problem of waterway development in the United States. Proposals for a general improvement of waterways have been agitated, but the chief interest has centered around the Lakes-to-the-Gulf project. Within this period the Lakes-to-the-Gulf Deep Waterway Association has held its six annual conventions; two national commissions have spent almost the entire period in investigating rail and water transportation at home and abroad; and a number of special boards of engineers have made reports on various waterway projects.

Among the many documents put forth by commissions, associations, and engineers, none presents an adequate study of the traffic conditions on the proposed route. This article and the one to follow are offered as a contribution to the study of the traffic side of the problem. The viewpoint is that of the economist and the traffic man. No discussion of the lowering of the lake levels, of power development, or of other strictly engineering problems is offered. Several boards of engineers, state[1] and national,[2] have reported plans and estimated costs for obtaining different depths of channel on the several sections of the route; and have estimated

[1] *The Illinois Waterway Report*, 1909, Internal Improvement Commission of Illinois.

[2] H. Doc. 263, 59th Cong., 1st sess. (Lockport to St. Louis); H. Doc. 50, 61st Cong., 1st sess. (St. Louis to the Gulf); H. Doc. 1374, 61st Cong., 3d sess. (Lockport to the mouth of the Illinois River).

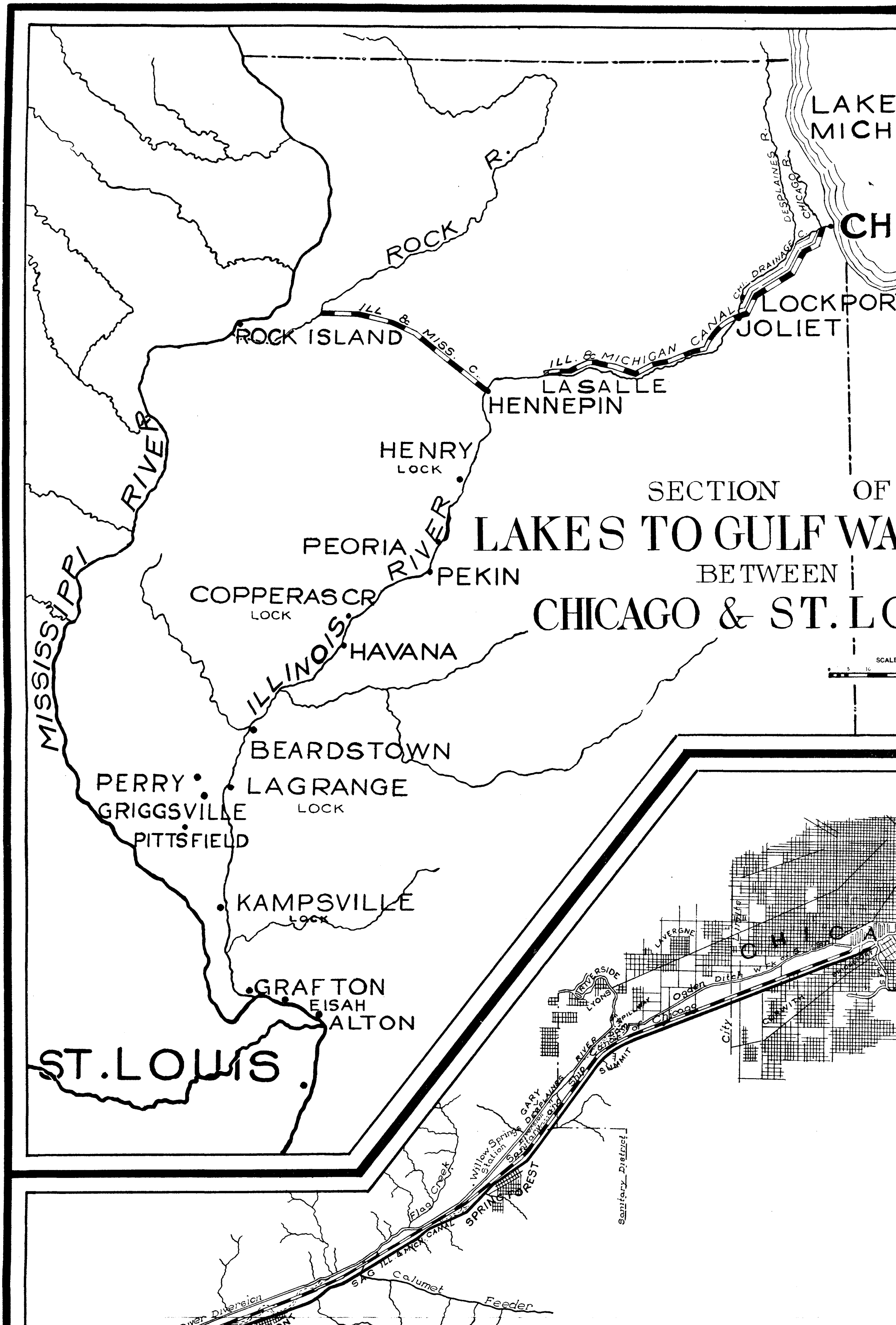
the amount of power that may be developed, and the effect that the flow of the current from Lake Michigan would have on the lake levels. However, a brief statement is here made of some of the physical characteristics of the route that bear directly on the economic problems at issue.

It is believed by some that it is practicable to develop traffic in ocean and lake vessels on the proposed Lakes-to-the-Gulf Deep Waterway; that the channel should be improved to a depth of from 20 to 30 feet, in order that ocean and lake vessels may be employed; that were this done, the cost of shipping would be so reduced that a phenomenal development would occur along the route, and that there would be a large saving in freight charges. But the effect that an improved waterway would have on railway rates is more commonly believed to be the justification for the expenditure of funds for the project. It is assumed that railway rates parallel to the route are much higher than boat rates would be on an adequate channel, that on an improved waterway competition among the boat companies would lower the boat rates, and that the boat rates would force a reduction in railway rates.

A knowledge of traffic conditions in the Valley is necessary to aid the reader in forming an opinion as to the effect that an improved waterway would have on industrial development, on traffic, and on rates. In these articles an attempt has been made to show the conditions under which the freight moves, and may be expected to move. An outline of the route, the water craft now employed on it, and the nature of the boat business are presented for the purpose of showing the conditions of freight movement. The amount of freight carried by rail and by river, the boat rates, the insurance and terminal charges, and the rail rates are tabulated, in order that a sane conclusion may be arrived at as to the social wisdom of constructing the waterway.

I. THE CHANNEL

The proposed waterway is made up of five different channels, namely: the Chicago River, the Chicago Sanitary and Ship Canal, the Des Plaines River, the Illinois River, and the Mississippi. The map shows the proposed route between Chicago and St.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SECTION OF
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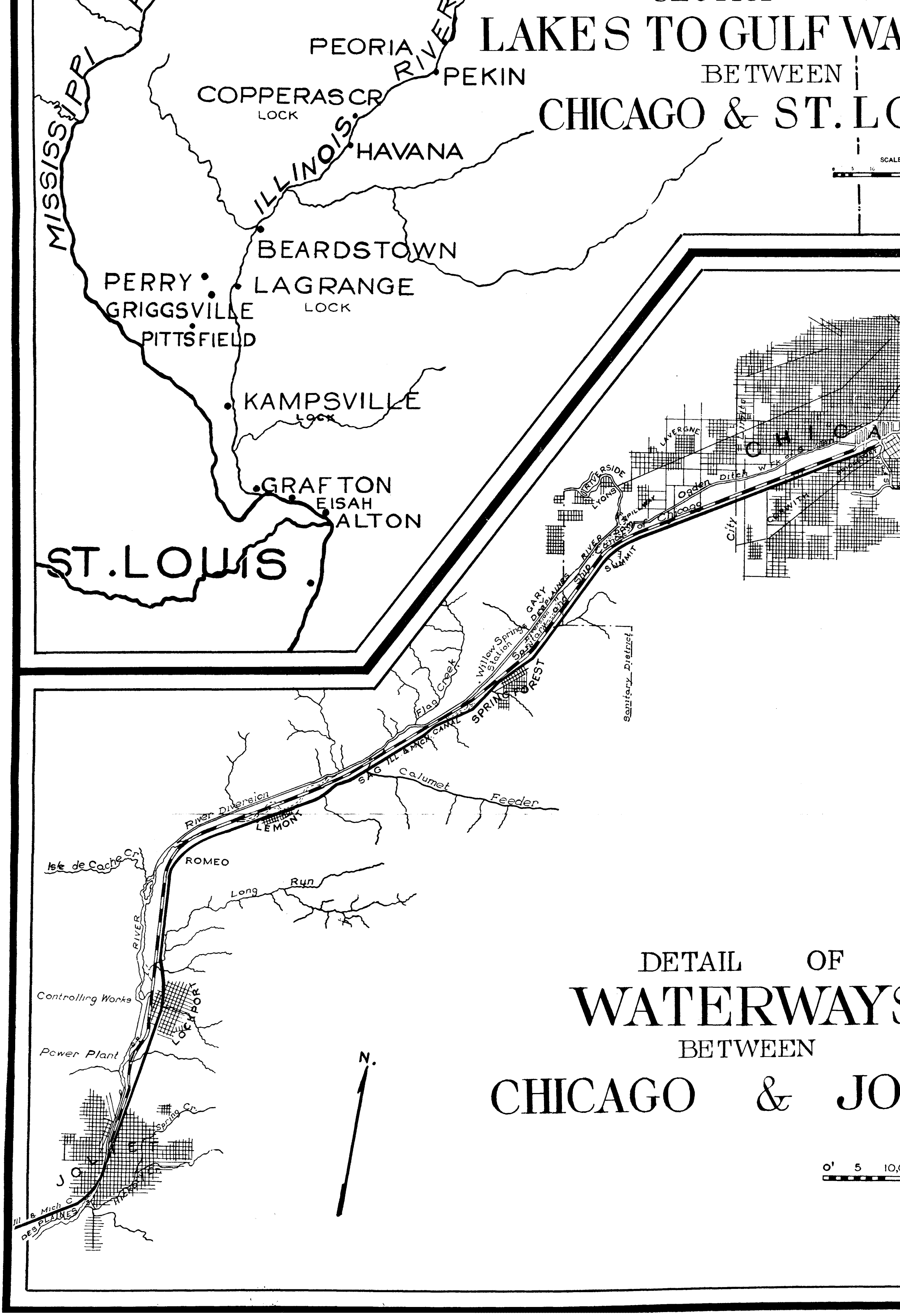
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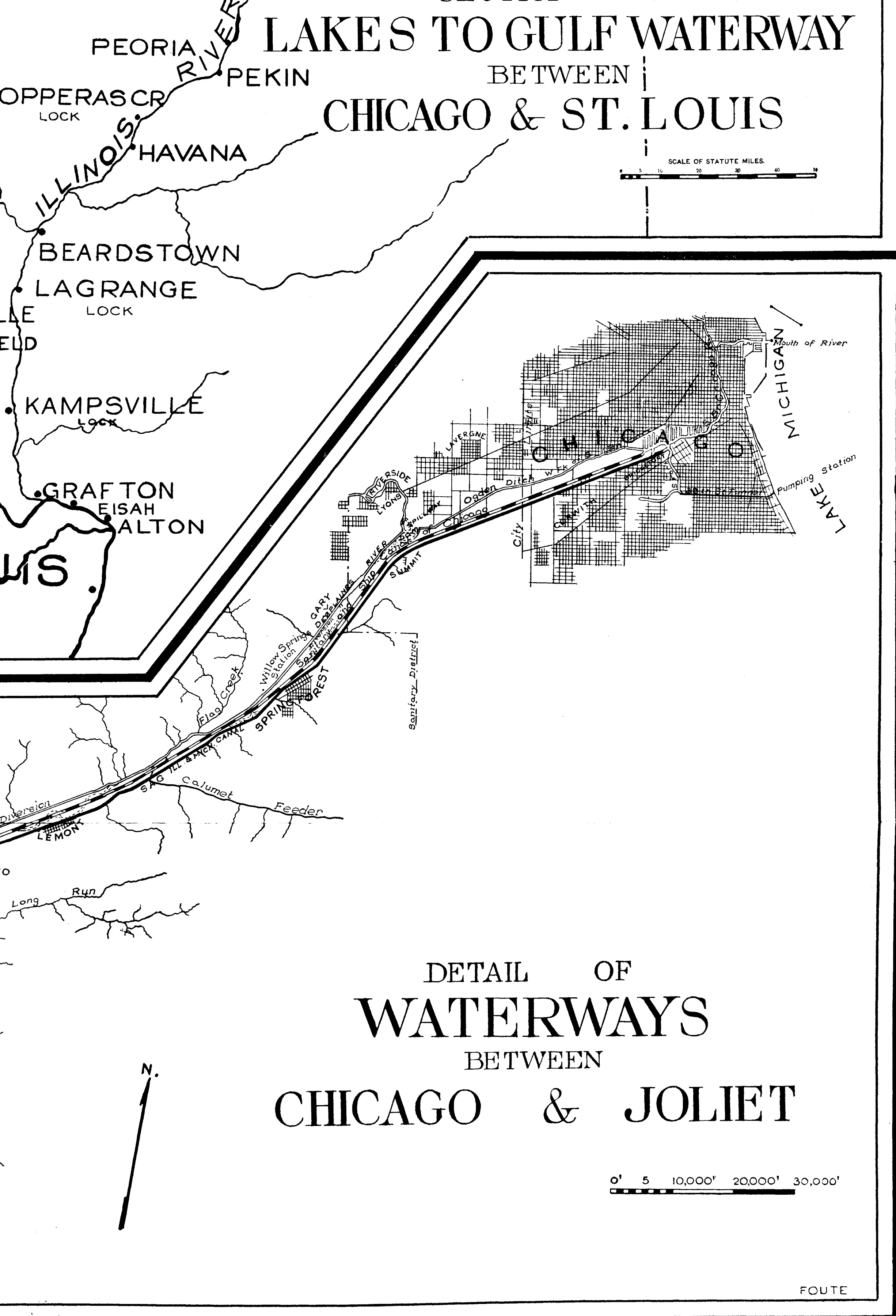
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SCALE OF STATUTE MILES.
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Louis; the channel of the Mississippi River between St. Louis and the Gulf composes the remainder of the route. Beginning at Lake Michigan and the mouth of the Chicago River, in the very heart of the city of Chicago, the route follows the Chicago River for 6.25 miles from Lake Michigan to Robey Street, the Chicago Sanitary and Ship Canal for 32.35 miles to the junction with the Des Plaines River and the Illinois and Michigan Canal at Joliet,[1] the Des Plaines River for 15.73 miles to the junction of the Kankakee,[2] the Illinois River for 273 miles to the Mississippi, and the Mississippi for 1,332 miles[3] to the Gulf of Mexico.[4] The total distance between Chicago and the Gulf is 1,659.33 miles.

It is perhaps worth while to study more in detail the several sections of the route.

The part of the Chicago River that is to be used for the waterway is divided into two sections, the Main River and the South Branch. The Main River extends from Lake Michigan for a distance of 1.58 miles. It is under the control of the national government. The depth is 21 feet[5] and the width from 220 to 300 feet.[6] The South Branch connects the Main River with the Sanitary and Ship Canal, and is under the control of the Sanitary District.[7] It has a mid-channel depth of from 20 to 26 feet, a dock-line depth of 16 feet,[8] and a width of from 100 to 200 feet.

Many obstacles hinder the development of shipping on the Chicago River. The river current, used to carry the sewage, is

[1] *Bull. No. 20,* War Department, 1911, pp. 150–63.

[2] H. Doc. 263, 59th Cong., 1st sess., p. 72.

[3] Channel distance, not mid-bank.

[4] H. Doc. 50, 61st Cong., 1st sess., pp. 33 and 329.

[5] Depths are referred to *Chicago city datum*—the low-water mark of Lake Michigan in 1847, 1.7 feet lower than mean lake level.

[6] *Survey of Northern and Northwestern Lakes,* Bull. No. 20, War Department, 1911, pp. 150–63.

[7] The Sanitary District of Chicago is a semi-municipal organization chartered by the state of Illinois. *The Sanitary District of Chicago, and the Chicago Drainage Canal, a Review of 20 Years of Engineering Work,* by Isham Randolph, 1909, gives historical and descriptive matter concerning the district.

[8] The docks must be rebuilt before the depth can be extended to the dock lines, and it is the policy of the Sanitary District to leave to the owners of the docks the improvement of their own property.

the most serious; while the city traffic across the channel and the cost of real estate along the banks needed for increasing the width are worthy of mention. Important industrial plants are located on sections of the unimproved part of the river from Sixteenth Street north, and twenty-seven city and railroad bridges span the 6.25 miles of the channel between the lake and the Drainage Canal. Ten of the bridges have center piers. The first from the lake in the Main River has a center pier, and the widest draw is only 73 feet in width. Other bridges farther up the river (or down the river, as the stream flows since it was reversed by the construction of the Drainage Canal) have still narrower draws. These, in conjunction with the curves of the channel and the velocity of the current, prevent the employment of the large lake freighters.[1]

The Sanitary and Ship Canal is thought by many persons, even in Chicago, to be a completed channel open for deep-draft vessels; while in fact only three of the bridges have been equipped with operating machinery,[2] and for 7.8 miles the channel has been dredged to but little more than half the projected width.[3] Following are the dimensions of the canal: From the river at Robey Street to Summit, 7.8 miles, the width is 110 feet at bottom and 198 feet at water line. From Summit to Willow Springs, a distance of 5.3 miles, the width is 202 feet at bottom and 290 feet at water line. From Willow Springs to the power plant at Joliet, a distance of 16.95 miles, the width is 160 feet at bottom and 162 feet at water line. The lock at Joliet is 130 feet in length, 22 feet in width, 12 feet in depth, and has a "lift" of 37 feet.[4] For the remaining two miles, the canal has a minimum width of 160 feet at bottom and 162 feet at water line, and a depth of 10 feet.

[1] See below, Section IV, p. 564.

[2] *Bull. No. 20*, War Department, 1911, p. 162.

[3] *Ibid.*, p. 161. This is the earth section and has been dredged on one side only. Mr. Lyman E. Cooley, C.E., made a statement before the Committee on Commerce of the Senate of the United States, February 28, 1910, in which he said that the width of the Drainage Canal was "202 feet on bottom in earth." See p. 22 of said statement. It is common opinion that the entire channel is 200 feet in width.

[4] Isham Randolph, Consulting Engineer, *The Sanitary District of Chicago and the Chicago Drainage Canal*, 1909; *Bull. No. 20*, War Department, 1911, pp. 161–62.

Between Chicago and Lockport the Sanitary and Ship Canal has a uniform depth of 22 feet. Fifteen bridges span the channel. Eight of these have center piers, six have only one draw dredged, and twelve are not equipped with operating machinery. The Sanitary District is not called upon to dredge the unimproved part of the channel until the population of the city requires it to be done; but it is bound by the act creating the district to equip the bridges and operate them. This has not yet been complied with.[1]

The Chicago River and the Chicago Sanitary and Ship Canal are now used as the main sewer of Chicago. The current flowing through these channels is drawn from Lake Michigan and discharged into the DesPlaines River at Joliet, Ill., 38 miles from Lake Michigan. The sewage borne by the current finds its way through the DesPlaines and the Illinois rivers into the Mississippi. The volume of water flowing in the channel of the river and the canal is regulated at Lockport. Under date of December 5, 1901, the Secretary of War granted permission to the Sanitary District so to regulate the discharge of water from the canal that the maximum flow should not exceed 4,167 cubic feet per second,[2] but the Sanitary District is now using about 7,000 second-feet.[3] There are two reasons for limiting the volume: a large flow (1) would obstruct navigation in the Chicago River by increasing the velocity of the current, and (2) would lower the lake levels. The International Waterways Commission has estimated that the diversion of 20,000 cubic feet per second would lower the "Lake Michigan-Huron" level about 13 inches and that of Lake Erie about 11 inches. The cost of restoring the previous depth of the harbors and channels of the Great Lakes, in the event of such a change in the lake level, is estimated at $12,500,000. Serious obstruction to the lake traffic would also result while the remedial work was being done.[4]

The velocity of the current in the Chicago River and the Drain-

[1] *Report on the Chicago Drainage Canal*, p. 2, International Waterways Commission, 1907; *Bull. No. 20*, War Department, 1911, p. 162.

[2] *Bull. No. 19*, War Department, 1910, p. 140.

[3] H. Doc. 1374, 61st Cong., 3d sess., 1911, p. 9.

[4] *Report upon the Chicago Drainage Canal*, International Waterways Commission, War Department, Doc. No. 293, 1907, p. 15.

age Canal is estimated at from 1.5 to 3 miles per hour. The narrow stretches of the canal force the greater velocity. In some of the bridge draws the velocity exceeds three miles an hour, and a material increase in the flow would probably result in the destruction of the shipping in important lake vessels, unless the width of the channel should be increased.

From Joliet to La Salle via the Des Plaines and Illinois rivers, a distance of 74 miles, there is a fall of 136 feet. To overcome the declivity it is proposed that this section be made navigable by means of locks. In narrow stretches canals are recommended to avoid high velocity of flood currents. This section of the route is not now navigable by river, but the Illinois and Michigan Canal connects the Chicago Sanitary and Ship Canal with the navigable portion of the Illinois River at La Salle, and affords a channel depth of 4 feet and 8 inches.[1]

The Illinois and Michigan Canal (at present the only navigable channel between Joliet and La Salle) has an average width of 60 feet at water line and 48 feet at bottom. There are 18 lift locks on the channel having a minimum length of 110 feet and a minimum width of 17½ feet at water line and 14 feet at the bottom of the locks. The minimum depth of the locks is 5½ feet and the overhead clearance is 11½ feet.[2]

The Illinois River has a low-water depth of 6 feet from La Salle to Peoria, and 7 feet from Peoria to Grafton, where it joins the Mississippi.[3] The four locks on this section are 350 feet in length, 75 feet in width, and 7 feet in depth. The first two locks below La Salle (at Henry and at Copperas Creek) are operated by the state, and tolls are collected; the other two (at La Grange and at Kampsville) are operated by the national government without charge. In the 220 miles between La Salle and Grafton the fall is only 33 feet. To obtain a channel 14 feet in depth the engineers

[1] The connection at Joliet between the Drainage Canal and the Illinois and Michigan Canal was made in July, 1910, and the depth given is that to be maintained during 1911.—*Bull. No. 20*, War Department, 1911, p. 163.

[2] From a letter sent to the writer by the Canal Commissioners of Illinois, May 8, 1911.

[3] *Bull. No. 20*, War Department, 1911, p. 163.

recommend the removal of the locks and the dredging of a channel having a bottom width of 200 feet. The cost of the project from Lockport to Grafton is estimated at $23,543,582.[1]

From Grafton, Ill., to Eads Bridge, St. Louis, the distance is 39 miles. The following excerpts from the report of the Mississippi River Commission, 1905, describe some of the characteristics of the section. The Commission says:

> About 23 miles below Grafton the Missouri River enters the Mississippi, completely changing the character of the latter stream below the junction and disturbing its regimen for many miles above.
>
> Immediately at the junction the changes of volume and of slope, due to the coincidence or non-coincidence of floods or of low water, are so frequent and so radical that it may almost be said that the river here has no regimen. . . . . The experience of the last 25 years in the efforts to gain a channel depth at low water on the Mississippi, below the Missouri, of 8 or 10 feet, does not encourage the belief that a depth of 14 feet can be secured and maintained without excessive expenditure of time and money.[2]

The commission recommends the construction of a dam at Alton and a canal extending from there to a point 18 miles below on the Mississippi. The canal is to have a bottom width of 160 feet and the locks are to be 600 feet in length, 80 feet in width, and 14 feet in depth. The cost of the project is estimated at $6,553,880.[3] This section, from Grafton to St. Louis, now has a mean low-water depth in the river channel of 6 feet and a width of 2,500 to 3,500 feet. The fall is 24.14 feet.

The low-water channel length of the river from St. Louis to the mouth of the Ohio is 182 miles; the air-line distance, 125 miles. From Cairo to the mouth of the Red River the channel distance is 790 miles; the air-line distance, 440 miles. From the mouth of the Red River to the Gulf the channel distance is 321 miles; the air-line distance, 210 miles.

The width between St. Louis and Cairo varies from 650 feet to 4,000 feet at zero stage, and from 800 feet to 4,900 feet at four-foot stage. The bank-full stage varies from 1,550 feet to 6,800

[1] H. Doc. 263, 59th Cong., 1st sess., p. 19.

[2] *Ibid.*, pp. 530–33.

[3] *Ibid.*, p. 544.

feet in width. Below Cairo various widths as small as 1,000 feet and as great as 7,500 feet at zero stage have been found. At bank-full stages the widths vary from less than 2,000 feet to 10,500 feet. The river becomes more uniform in the lower section, and averages somewhat less in width. Through a large part of the distance from Cairo to the mouth of the river, floods are confined between a levee on one side and highlands on the other; and through another large part, within levees along and near both sides. This restricted flood width averages from 5 to 10 miles, but decreases to about two miles in the lower section.[1]

The fall at low water from St. Louis to Cairo is 7.39 inches per mile, while from Red River to the head of the passes it is less than ¼ of an inch per mile. Table I shows the slope and the depths from St. Louis to the Gulf.

TABLE I

THE SLOPE AND THE DEPTHS OF THE MISSISSIPPI RIVER FROM ST. LOUIS TO THE GULF OF MEXICO[2]

Stations	Distances (Mid-Bank)	Fall at Low Water	Average Depth at Low Water	Least Depth at Low Water
	Miles	Feet	Feet	Feet
St. Louis to Cairo	175	107.86	18	8
Cairo to Memphis	230	89.52	31½	9
Memphis to Vicksburg	369	141.86	37	9
Vicksburg to Red River	154	36.69	48½	9
Red River to passes	291	6.08	84	30

As the declivity decreases, the depth increases. The decreased width on an almost level river-bed increases the depth; but if the slope were steep it would increase the velocity. The engineers have made it clear that a decreased width between St. Louis and Cairo would increase the velocity and the scouring capacity of the current.[3]

The Board of Engineers states that the Mississippi River from St. Louis to the Gulf is typically a river with an unstable bed, that

[1] H. Doc. 50, 61st Cong., 1st sess., pp. 33, 34.

[2] *Ibid.*, p. 34; *Annual Report of the Chief of Engineers*, 1909, pp. 550–52.

[3] The greater weight of water on the bottom of a deep channel gives increased carrying and scouring capacities. This is the secret of the capacity of the Mississippi to carry its load of silt into the Gulf through an all but level channel.

is, one of caving banks and shifting bottom. The report says: "No river in the world, under improvement for purposes of navigation, equals it in the magnitude of its bed disturbances." It is stated that the amount of material carried "is over 20 times as much as is carried annually by the Danube, Dnieper, Volga, Rhone, Nile, or La Plata, and over fifty times as much as by the Loire and Durance, although these foreign rivers are considered specially difficult of improvement because of their silt and other water-borne material." The board states, however, that the experience of the government engineers during many past years has shown that protection of banks, by mattress below low water and by paving above, can be secured anywhere along the Missouri and the Mississippi rivers.[1]

The Mississippi River Commission has, for its present project, to maintain a channel of 8 feet from St. Louis to Cairo and of 9 feet from Cairo to the mouth of the Red River. This has been accomplished except for very short periods at a few bars.[2] The following excerpts from the report of the Special Board of Government Engineers, made in 1909, state the present condition of the channel in regard to navigation. The engineers say:

. . . . it has been possible for several years, even during low-water seasons, to freely send boats of 25 to 30 feet draft from the Gulf 270 miles to New Orleans, Baton Rouge, and Bayou Sara, 9 feet draft thence 840 miles to Cairo, 8 feet draft thence 182 miles to St. Louis, thence $4\frac{1}{2}$ feet draft 365 miles up the Mississippi and Illinois rivers and through the Illinois State Canal to Chicago.

On the Mississippi River from St. Louis to Cairo the increase in depth and width of channel during past years, while under improvement by the Engineer Corps, has been quite marked, and today there are only a few days at a time for a few times each year when a boat drawing 8 feet cannot freely go up and down the river anywhere between St. Louis and Cairo.

The delays of navigation on this stretch of river . . . . are trifles in comparison to the winter delays of navigation on the Great Lakes, where the boat commerce is many times greater and where all reasonable demands of commerce are today fully met and satisfied.

On the Mississippi River below Cairo the river is also in far better condition now than ever before, and except for a few days a few times each year there has been maintained for several years a least depth of 9 feet, capable of

[1] H. Doc. 50, 61st Cong., 1st sess., pp. 40–48.

[2] *Annual Report of the Chief of Engineers, U.S. Army*, 1909, pp. 550–52.

carrying all boats that may reach it from the Ohio River after the improvements in progress thereon shall have been completed.

This waterway . . . . is, as a whole, the equal of anything in Europe, where much of the canal and up-river boat traffic is done on 3 feet draft; most of it is done on 6 to 8 feet draft, and where as much as 10 feet draft is exceptional.[1]

The same board reported that the open-river plan of improvement between St. Louis and the Gulf was more practical than that of any system of canals or combination of open channel and canals. This plan includes dredging and bank protection with the addition at certain localities of works to contract the channel. The cost of securing a 14-foot channel by this method is estimated at $128,600,000 for construction and $6,500,000 annually for maintenance after the completion of the project. If to this be added the $30,097,462 for first cost and $310,000 for annual maintenance of the section from Lockport to St. Louis, the total estimated cost for a channel 14 feet in depth from Lockport to the Gulf is $158,697,462 for construction and $6,810,000 annually for maintenance.[2] The cost of completing the Sanitary Canal and of widening the Chicago River would probably be not less than $100,000,000; and the cost for maintenance, including the dredging for the waste from the sewage, would probably be not less than three or four millions of dollars. The total cost for the construction would be approximately a quarter of a billion of dollars and for maintenance roughly $10,000,000.

II. TERMINALS AND TERMINAL EQUIPMENT[3]

Concerning the ports and landings on the route of the proposed waterways, it is the purpose (1) to present briefly the present conditions of the more important landings and ports, and (2) to discuss the advisability of improving them.

In considering the advisability of equipping the ports and landings, the problem of most importance is that of the relation of cost to returns. The combined interest and maintenance charge for

[1] H. Doc. 50, 61st Cong., 1st sess., pp. 329–30.

[2] *Ibid.*, pp. 12–21.

[3] This part of the study is confined to a few conditions at the terminals. Cf. *Transportation by Water in the United States*, Part III, 1910, Bureau of Statistics.

port equipment may not be large per ton of freight cared for at ports that accommodate great volumes of traffic. But the corresponding charge may be much larger at ports through which pass insignificant amounts of freight. There are difficulties, moreover, at Mississippi landings not encountered at most important ports where excellent facilities for handling freight are found. Attention is directed to a few only of the more salient features of the problem.

The Chicago River has long been the harbor of Chicago. The physical conditions of the river, the difficulties of navigation, and the advisability of constructing a harbor on the lake front have already been discussed. The docks on the Chicago River are owned by private parties, and the larger number of them have a depth of only 16 feet. Those on the Main River, however, have a depth of 21 feet; and a very large part of the freight is now handled at these docks.

Probably all boats that will be able to navigate the channel between Chicago and St. Louis can discharge their cargo at the present docks, even at those on the South Branch of the river. Moreover, the center of the channel on the South Branch of the river is now from 20 to 26 feet in depth, and the owners of the docks may improve them at no great cost. The authorities of the city are also planning to construct a modern wharf on the lake front near the mouth of the river. It is to be equipped with machinery for handling freight at the smallest cost practicable. In view of these conditions and improvements it would seem that river shipping will lack nothing in harbor equipment at Chicago.

Chicago and New Orleans have two important advantages over the other towns and cities on the route. (1) There is little oscillation in lake and river stages at their wharves, and (2) the cost of constructing and maintaining an adequate wharf may be met by lake and ocean commerce. In this respect, the contrast between these two cities and the other towns and cities on the route is shown in the following paragraphs.

At St. Louis there is an oscillation of 43 feet in the stage of the river. This oscillation would make it expensive to construct a vertical wharf. A floating wharf constructed by the city and made free for all boats would aid the boat business. But how much this

would increase the boat traffic is problematical. The sloping wharf or landing now maintained furnishes not only ample space but more than is used. There was a time when boats could scarcely find space to land at St. Louis, but it has passed. The limited amount of freight now seeking the landing would not justify an elaborate expense for a terminal.

At Cairo there is an oscillation of 50 feet in the river stage. Here the same difficulty is met as at St. Louis. It is not practicable to construct a vertical wharf. The wharf at this point is controlled by a double monopoly, a private company improved the wharf and now leases it to floating wharfboat companies. There is complaint that the wharfage is excessive, and it seems that the city should control the wharf. There is ample space, however, on the present improved wharf for more wharfboats than will ever be needed.

At Memphis there is no great stretch of public wharf, but not one-fifth of the present wharf is used. The Lee Line, the most important line on the Mississippi River, has a small warehouse at this point. The freight is carried up or down the river bank to or from the warehouse, the capacity of which is some two carloads. The oscillation in the river stage is about 45 feet.

At Greenville freight is carried from 100 to 300 yards across the levee. The distance depends on the stage of the river. There was at one time a coal tipple in operation here. Coal was shipped from mines near Greenville via the Southern Railway to the tipple and reshipped by boat to the lower river. This has entirely ceased now, however. Coal is brought to Greenville from Pittsburgh in barges and carried across the levee in wheelbarrows. The gangway across the levee from the landing to the coal yard is from 200 to 400 yards in length. Some 10 Negroes are occupied for from 12 to 14 days in unloading a barge of 500 or 600 tons of coal, and it is said that the cost of unloading alone is more than $1.00 a ton. The Monongahela Coal and Coke Company of Pittsburgh, one of the largest companies in the country, is the distributor of coal on the lower river; and if it were practicable to equip the landings, the corporation would probably have them equipped for handling coal.

At Vicksburg, of the one mile of wharf the city owns about

2,500 feet. The oscillation is about 40 feet, and no fixed wharf has been attempted. The Commissioner of Corporations calls attention to the "high and steep" land adjacent to the landing used by the packet boats. He does not state why the boats are landed on the steep bank in preference to the level space farther down the river. The explanation is as follows: Even a packet of a draft of 4 or 5 feet cannot moor near enough to a bank of gentle slope to swing the gangplank ashore. If the boats landed at the gentle slope farther down the river the variation in the landing spot, at high and at low water, would probably be 300 yards. This is the problem of wharf improvement on the lower Mississippi. Vertical wharves that would meet all stages of the river would cost dear, and at the same time be of little use at low stages of the river, because of the very height of the wharf above the deck of the boat. At Vicksburg the difficulty is met, if not solved, by the use of the steep part of the landing; while at most of the larger landings, the floating wharfboat is used.

The ocean commerce of New Orleans is now far more important than the river shipping; but even the latter is still worthy of consideration. Inasmuch as the oscillation in the stage of the river is only 19 feet, the construction of vertical wharves is not very expensive. There is no terminal obstruction to the river business at New Orleans. A large part of the wharf is under public control, and encouragement is given to river shipping. The freight movement is discussed elsewhere.

It is commonly believed that the most necessary aid to commerce on the Mississippi is better terminals. European ports teeming with river commerce are cited as examples of wharf improvement which the cities on the Mississippi should follow. But the oscillation in the river stage is from 40 to 50 feet between St. Louis and Baton Rouge. How could wharves and warehouses that would serve all stages of the river be constructed at a cost not more than commensurate with the benefits received? It would certainly be uneconomical to equip all of the way landings with adequate wharves; and yet the larger part of the present packet shipping is either received or discharged at small landings. Moreover, the problem is not that of river frontage for boat landings. There is

more wharf space than would be needed for many times the present commerce. At Chicago the private docks on the Chicago River are scarcely used at all, and at the smaller landings, of course, there will never be any congestion of boats.

III. WATER CRAFT AND BOAT LINES

The history of the construction of water craft on the Mississippi River System is closely allied with the history of the river business. Table II shows the number and gross tonnage[1] of all documented steam vessels built on the Mississippi River and its tributaries for quinquennial periods from 1811 to 1910.

TABLE II

NUMBER AND GROSS TONNAGE OF DOCUMENTED STEAM VESSELS BUILT ON THE MISSISSIPPI RIVER AND ITS TRIBUTARIES FOR QUINQUENNIAL PERIODS, 1811–1910*

Period	Number of Vessels	Gross Tonnage	Average Tonnage per Vessel	Average Number of Vessels per Year	Average Gross Tonnage per Year
1811 to 1815	9	1,589	177	1.8	347.8
1816 to 1820	62	12,620	204	12.4	2,523.0
1821 to 1825	69	10,075	146	13.8	2,015.0
1826 to 1830	156	27,225	175	31.2	5,445.0
1831 to 1835	270	35,720	132	54.0	7,144.0
1836 to 1840	459	72,284	157	91.8	14,456.8
1841 to 1845	495	87,552	177	99.0	17,510.4
1846 to 1850	638	124,534	195	127.6	24,906.8
1851 to 1855	671	160,157	239	134.2	32,031.4
1856 to 1860	675	147,465	218	135.0	29,493.0
1861 to 1865	706	153,573	218	141.2	30,714.6
1866 to 1870	504	142,578	283	100.8	28,515.6
1871 to 1875	588	128,054	218	117.6	25,610.8
1876 to 1880	596	124,275	209	119.2	24,855.0
1881 to 1885	551	97,577	177	110.2	19,515.4
1886 to 1890	369	54,683	148	73.8	10,936.6
1891 to 1895	392	51,864	132	78.4	10,372.8
1896 to 1900	480	59,184	123	96.0	11,836.8
1901 to 1905	728	42,592	59	145.6	8,518.4
1906 to 1910	916	29,418	32	183.2	5,883.2

* *Transportation by Water*, 1906, p. 165, Special Reports, Bureau of the Census, Department of Commerce and Labor; *Annual Report, Commissioner of Navigation*, 1910, p. 222.

The table shows that from 1811 to 1865 there was a continuous increase in the number of steamers constructed; while from 1866

[1] In this chapter the word tonnage is used to designate the registered capacity of vessels and should be distinguished from the amount of freight carried, or cargo.

to 1890 there was a decrease. From 1891 to 1910 there was again an increase in the number, but a decrease in the total tonnage and in the tonnage per vessel. That is, a larger number of small vessels was built. In gross tonnage the maximum was attained in the period from 1851 to 1855, the figure had fallen to less than one-fifth as much in the period from 1906 to 1910. In tonnage per vessel the maximum was reached in the period from 1866 to 1870, when the average was more than eight times as great as in the period from 1906 to 1910.

Table III gives the number and gross tonnage of the steam vessels documented on the "Western Rivers,"[1] classified according to tonnage groups for the years 1889, 1906, and 1910.

TABLE III

NUMBER AND GROSS TONNAGE OF STEAM VESSELS ON THE "WESTERN RIVERS" BY TONNAGE GROUPS, 1889, 1906,* AND 1910†

Year	Class		1		2		3		4		5		6	
	Total		5 to 49 Tons		50 to 99 Tons		100 to 499 Tons		500 to 999 Tons		1,000 to 2,499 Tons		2,500 to 4,000 Tons	
	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage	No. of Vessels	Gross Tonnage
1889..	1,114	209,826	270	7,933	261	19,345	493	103,358	67	49,026	23	30,164	...	.....
1906..	1,451	152,592	754	14,057	300	22,508	339	72,289	57	33,784	7	9,954	...	.....
1910..	1,677	140,781	1,064	16,742	282	21,120	274	58,780	49	31,860	7	9,754	1	2,525

* *Transportation by Water*, 1906, p. 166, Department of Commerce and Labor.

† *Annual Report, Commissioner of Navigation*, 1910, p. 206

The total tonnage shows a decrease of almost one-third while the number of vessels increased from 1,114 to 1,677. With the exception of one vessel in the sixth class, the increase in number was in the first and second. In these classes there was a gain of 815 vessels. That is, the increase in number was almost entirely in vessels of which the capacity was less than 50 tons. Classes three, four, and five show a decrease in both number of vessels and tonnage. The development of the gasoline power boat is partly responsible for the increase in the number of the smaller vessels;

[1] The term "Western Rivers" includes the Mississippi River and tributaries only.

but the falling-off of river traffic made large boats unnecessary and uneconomical, and the situation was met by the construction of smaller steamers.

Table IV shows the documented steam vessels on the Illinois River and on the lower Mississippi for the years 1889, 1895, 1900, and 1910.

TABLE IV

DOCUMENTED STEAM VESSELS ON THE ILLINOIS RIVER AND THE LOWER MISSISSIPPI, 1889, 1895, 1900, AND 1910*

Customs Districts	1889			1895			1900			1910		
	No. of Vessels	Gross Tonnage	Average Tonnage	No. of Vessels	Gross Tonnage	Average Tonnage	No. of Vessels	Gross Tonnage	Average Tonnage	No. of Vessels	Gross Tonnage	Average Tonnage
Peoria, Ill.	...	......	...	9	458	51	11	431	39	16	821	51
St. Louis, Mo.	115	42,827	372	109	38,703	355	107	30,860	288	99	16,539	167
Cairo, Ill.	...	......	...	17	3,954	233	20	2,928	146	18	1,730	96
Memphis, Tenn.	71	12,117	171	69	9,025	131	90	12,180	135	193	10,425	54
Vicksburg, Miss.	30	2,876	96	21	2,819	134	26	3,852	148	48	4,801	100
Natchez, Miss.	4	592	148	4	580	145	2	349	175	6	1,136	189
New Orleans, La.	126	19,246	153	127	17,298	136	113	16,423	145	203	14,343	71
Total	346	77,658	188	356	78,837	169.2	369	67,023	153.7	583	49,795	104

* *Transportation by Water*, 1906, p. 169, Department of Commerce and Labor; *Report of Commissioner of Navigation*, 1910, pp. 183–84.

For the twenty-two years from 1889 to 1910 the number of vessels increased from 346 to 583, while the tonnage decreased from 77,658 to 49,795, and the average tonnage per vessel decreased from 188 to 104. Again there appears a decrease in total tonnage and in average tonnage per vessel, but an increase in number of vessels. It is sometimes said that the lack of a channel of sufficient depth has been a cause of the decrease in the size of vessels. But the engineers have pointed out that the depth has been increased throughout the entire navigable part of the route.[1]

Table V shows the number and tonnage of steam vessels and barges documented on the proposed Lakes-to-the-Gulf Waterway at the offices of the several customs districts for the year 1910.

There were only 8 barges documented on the route, 4 at St. Louis, 2 at Cairo, and 2 at Vicksburg. Barges documented on the

[1] See above, pp. 549–50.

Ohio, however, ply between Cairo and New Orleans, and Cairo and St. Louis.

TABLE V

NUMBER AND TONNAGE OF STEAM VESSELS AND BARGES DOCUMENTED ON THE ILLINOIS RIVER AND ON THE LOWER MISSISSIPPI, 1910*

CUSTOMS DISTRICTS	STEAM VESSELS		BARGES		TOTAL	
	Number	Tons	Number	Tons	Number	Tons
Peoria, Ill.	16	821	..	....	16	821
St. Louis, Mo.	99	16,539	4	1,447	103	17,986
Cairo, Ill.	18	1,730	2	1,147	20	2,877
Memphis, Tenn.	193	10,425	..	...	193	10,425
Vicksburg, Miss.	48	4,801	2	76	50	4,877
Natchez, Miss.	6	1,136	..	...	6	1,136
New Orleans, La.	203	14,343	..	...	203	14,343
Total	583	49,795	8	2,670	591	52,465

* *Report of Commissioner of Navigation,* 1910, p. 203.

Table VI shows the number, the tonnage, and the class of vessels more or less regularly plying on the lower Mississippi River, including vessels documented on the Ohio, for 1906. One striking feature of this table is the large number of barges and tows plying on the lower Mississippi, since there are so few barges documented on that section of the river. It is also worthy of notice that the registered

TABLE VI

THE NUMBER, THE TONNAGE, AND THE CLASS OF VESSELS PLYING ON THE LOWER MISSISSIPPI, 1906*

CLASSES	NUMBER	TONNAGE	PROPORTION OF ENTIRE MISSISSIPPI SYSTEM	
			Number Percentage	Tonnage Percentage
Commercial vessels—				
Tugs and towboats	131	10,004	21	16
Packet boats	90	17,474	23	32
Barges and tows	354	94,213	24	2
Ferryboats	52	14,496	33	65
Yachts	37	858	17	26
All others	8	437	21	20
Grand total	672	137,482	7	3

* *Transportation by Water,* 1906, p. 173, Department of Commerce and Labor.

tonnage of the vessels plying on the lower Mississippi is only 3 per cent of that of the entire Mississippi system.

From 1880 to 1900 there was a remarkable extension in the use of barges as bulk carriers for distance traffic, mainly in coal, on the Ohio and the lower Mississippi rivers. In 1906 the unrigged vessels[1] (unequipped with power) formed 95 per cent of the total vessel tonnage on the rivers of the Mississippi system. The tonnage of this class of vessels had increased 34 per cent from 1889 to 1906. During the last few years, however, there appears to be a decrease in the barge tonnage in sympathy with the decline of river business in general, and with the decrease in the shipment of coal and lumber in particular. The amount of coal carried has fallen off notably since 1901, as shown elsewhere.

The Ohio barges are noted as carriers of bulk cargo. The coal fleets that carry Pittsburgh coal to points on the Ohio and Mississippi rivers are the most picturesque of all inland water craft in the United States. The barge fleets of the lower Ohio and Mississippi rivers are frequently more than 300 feet in width and 1,100 feet in length. They are made up of powerful towboats and as many as fifty or sixty "coal boats"[2] and fuel boats. The dimensions of these fleets would prevent their being employed in canals and locks of ordinary dimensions.

What are known as "coal boats" are usually about 175 feet in length, 26 feet in width, and 10 feet in depth, and carry about 1,000 tons of coal. They are cheaply built, of light hemlock, cost about $850 each, and are employed chiefly in the "long river" trade from the shipping points on the Monongahela, Ohio, and Kanawha rivers, to New Orleans and other points on the Mississippi. Many of them are sold in the South for firewood, "shacks," etc., after one or two trips, as the cost of returning and repairing them is about as much as the cost of new boats.[3]

Coal barges, so called, average 135 feet in length, 26 feet in width, and 8½ feet in depth, and carry about 550 short tons of coal. They are substantially built and last about fifteen years. They are used chiefly in the "short river" trade to Cincinnati, Louisville, Cairo, and St. Louis.

[1] Unrigged vessels include a great variety of types, such as barges, canal boats, flatboats, lighters, scones, dredges, derricks, and floating elevators.

[2] H. Doc. No. 492, 60th Cong., 1st sess., pp. 18, 19.

[3] The practice is not so common as formerly.

Freight barges are of various sizes. The most substantial are the so-called "model barges," built on the model of a steamboat hull decked over, but without machinery. A typical barge, 225 feet long, 36 feet wide, and 10 feet deep, will cost about $10,000, but such barges are built costing from $6,000 to $20,000. They are used mainly to carry steel rails, wire, and other freight downstream, and bring back molasses, sugar, and lumber.[1]

The number of barges in a tow varies with the stretch of the river and the size of the towing steamer. In the upper Ohio, starting from Pittsburgh Harbor, a steamer will take a mixed fleet of 25 barges, boats, and flats, containing from 15,000 to 20,000 tons of coal. Such fleets go as far as Louisville where larger tows are made up for the lower Ohio and the Mississippi rivers, running as high as 35,000 to 56,000 tons. The steamboat is attached to the rear of the fleet of barges, but the barges are never floated down the rivers as they were in the old days. The power must be kept up to keep the tow in the channel, and is shut off only occasionally in maneuvering the fleet.

The use of steel barges in the Ohio River coal trade is as yet only experimental. There can be no question as to the desirability of this type of craft, but the initial cost and maintenance in the way of cleaning and painting are serious obstacles, as well as the interest charges, in view of the limited number of trips that can be made under present river conditions. Less than two trips can be made to New Orleans in a year.[2]

The barge fleets that ply on the open Mississippi and Ohio rivers cannot use ordinary canals such as have been projected in connection with the Lakes-to-the-Gulf Waterway between Chicago and St. Louis. Hence the economy that is obtained on the Ohio and lower Mississippi rivers by barge fleets could not be expected on the section of the route between Chicago and St. Louis. Even the wide locks and canals now being constructed on the Ohio will not provide sufficient space for the coal fleets that use the open river.

Table VII shows the class, the number, and the gross tonnage of metal vessels documented on the Illinois and the lower Mississippi rivers for 1910. Only one metal barge was documented, and of the 55 steam metal vessels, 25 were documented at New Orleans and 10 at Memphis.

[1] It is rare that they are loaded on the return trip. This is the style of barge which was used to carry grain from St. Louis to New Orleans prior to 1904.

[2] *Transportation by Water in the United States*, Part I, pp. 148–49, Department of Commerce and Labor, 1909.

TABLE VII

CLASS, NUMBER, AND GROSS TONNAGE OF METAL VESSELS DOCUMENTED ON THE LOWER MISSISSIPPI, 1910*

Customs Districts	Steam Vessels		Barges		Total	
	Number	Tonnage	Number	Tonnage	Number	Tonnage
Peoria, Ill.	..	.....	..	.....	..	.....
St. Louis, Mo.	11	2,977	1	1,162	12	4,139
Cairo, Ill.	2	80	..	.....	2	80
Memphis, Tenn.	10	1,829	..	.....	10	1,829
Vicksburg, Miss.	3	2,280	..	.....	3	2,280
Natchez, Miss.	3	422	..	.....	3	422
New Orleans, La.	25	5,832	..	.....	25	5,832
Total	54	13,420	1	1,162	55	14,582

* *Report of Commissioner of Navigation*, 1910, p. 191.

The "flat-bottom stern-wheeler" still holds its pre-eminence as the prevailing and most useful type of steamboat on the Mississippi. Side-wheelers, where used, are employed mainly for packet service, and especially ferry service; and the center-wheelers almost exclusively for ferry service. Although the screw-propelled vessels constitute 24.8 per cent of the power craft on the river, they represent but 6 per cent of the tonnage. The larger portion of this tonnage is made up of gasoline tow boats and yachts. The Mississippi River and its tributaries had, in 1906, almost as many wooden boats as the rest of the United States; but there is a tendency at the present time, by reason of their shorter life, the higher rate of insurance, and greater cost for repairs, toward the substitution of steel and iron boats.[1]

Concerning the gasoline boat, Mr. Story B. Ladd of the Census Bureau says:

> The use of small gasoline boats has developed greatly within the last few years, and they are employed in all kinds of work . . . . in freight and passenger and ferry service and in towing. The number and tonnage of these small excluded [from the Census] vessels and the transportation service performed by them must amount, in the aggregate, to large figures, and if included in these statistics, would add materially to the totals. For example one party

[1] The Lee Line has recently built, and now has in operation, three packets with steel hulls, the "Rees Lee," the "Ferd Herold," and the "Bob Lee, Jr." It is the purpose of the management of the Lee Line to construct new vessels of steel.

does a large amount of business with a fleet of 5 gasoline towboats, each under 5 tons, and hence not included in the canvass. If a bargeload is too heavy for one boat, two or more are used as the case requires. A large amount of the river business is being captured by the small gasoline boats, since they do not require license or inspection, and since the economical advantages favor them; while the regulations governing steam craft . . . . operate against the use of small steam craft.

When the writer was on the river in 1910 and in 1911, he noted the launching of new gasoline boats at St. Louis and other points. At Vicksburg there is considerable traffic in lumber and other commodities by gasoline towboats of the stern-wheel type. These gasoline tugs tow "flatboats" on which the freight is loaded, and by this means can land at very shallow wharves and carry freight very cheaply. As the steamers that at one time plied between St. Louis and other up-river points and New Orleans were supplanted by the local packet, so the larger packets now plying between such points as St. Louis and Memphis, and Vicksburg and New Orleans, are in danger of being crushed between the gasoline boat on the one hand and the railways and barges on the other. What the changes in equipment will be in the next decade or two may be hazardous to predict. But it appears that barge lines can move bulk freight over long distances more cheaply than any kind of packet steamer, that gasoline boats can handle freight for short hauls in small bulk more cheaply than packet steamers, and that railways can handle most carload freight between competitive points more cheaply than the packet steamers. If these are the conditions it would seem that an increase in the packet steamer equipment could hardly take place.

No record is kept of the draft of documented vessels on the inland waters of the United States. The writer has been unable to find anything written on the draft of the vessels of the lower Mississippi, except an occasional reference to the draft of certain vessels or classes of vessels. However, by going aboard the packet boats at lower Mississippi points it was learned that the maximum draft of this class of boat is from 22 inches to 8 feet. The latter extreme depth is drawn only by vessels plying between New

Orleans and Vicksburg. The draft of the 10 steamboats of the Lee Line varies from 22 inches to $4\frac{1}{2}$ feet.[1]

In the latter part of April, 1910, the writer inquired of the officials on board a number of vessels at St. Louis concerning the loaded draft of vessels then leaving the city. Not one of them drew more than five feet of water. It was learned that it was rare that freight enough could be obtained to load to a draft of even five feet. Two officials of different companies on the lower Mississippi stated that they were never forced to load light on account of low water, that they did not remember the time when they had been forced to leave a pound of freight on the wharf at St. Louis. They said: "We do not need more water, what we want is more business." Another traffic official of a boat company at Greenville repeated this same thought. One manager said, in an exasperated mood, that there never would be any increase in river traffic unless the present rail rates between river points should be raised, that an increased depth would have no effect on the amount of freight that would be offered. Other officials of boat companies on both the lower and the upper river made the same statements in substance. One traffic manager gave the writer a letter setting forth this view, and stated that there was no hope for the boat business until the long-and-short-haul clause was made to apply to river points as well as non-river points. There seems to be a general consensus of opinion among boatmen that what they need is more business instead of more water. These opinions indicate that the draft of vessels is not limited by the depth of the channel.

One factor in determining the draft of vessels on the Mississippi is the slope of the numerous landings. The small landings have not sufficient slope to allow vessels of deep draft to reach land with the gangplank. Again the small amount of freight handled at each mooring makes it more economical to operate a small boat than a large one. There is no necessity therefore for a vessel of deep draft; while there is an advantage in operating a vessel of shallow draft.

The barges and towboats are usually constructed for deeper

[1] This information was obtained from G. P. Lee, vice-president of the Lee Line, hile aboard one of the boats in April, 1911.

draft than the packets. The Barrett Line of Cairo owns towboats and barges of the following drafts:[1]

Draft, in Feet	Number of Vessels	
	Towboats	Barges
$7\frac{1}{2}$	1	4
$6\frac{1}{2}$	0	5
6	2	10
4	1	0
3	0	4

The common draft on the lower Mississippi for barges and towboats is from 4 to $7\frac{1}{2}$ feet. Very few of these vessels draw as much as 8 feet of water. Barge fleets make but few landings, and do not moor to receive or discharge small amounts of freight. That is, the factors that make for extremely shallow boats, in the case of the packet, do not limit the depth of barges and towboats to so great an extent.

The number of boat lines on the lower Mississippi River has greatly decreased during the last few decades. Until a few years ago there were boat lines maintaining regular schedules between St. Louis and the Ohio River points and New Orleans. There were also many lines operating for short distances. The through routes had been abandoned, except the barge lines between Ohio River points and New Orleans, until the Mississippi Valley Transportation Company opened a new line between St. Louis and New Orleans in 1911. The local lines, too, have decreased in number.

The most important packet line on the lower Mississippi is the Lee Line, which operates between St. Louis and Memphis, between Ohio River points and Memphis, and between Memphis and Vicksburg. A number of short lines operate on the lower Mississippi, but there is no through line between Memphis and New Orleans, except that of the Mississippi Valley Transportation Company. The Eagle Packet Company operates between St. Louis and Peoria, and the La Salle & Peoria Packet Company, between Peoria and La Salle, Ill.; but there is no line operating between La Salle and Chicago.

[1] Figures communicated by the Barrett Line.

The barge lines carry the bulk freight on both the Ohio and the Mississippi rivers. The most important are the coal-carriers between the Ohio River and the lower Mississippi River points, including St. Louis. Certain barge lines, however, carry miscellaneous bulk freight, such as lumber, ties (wooden), manufactured iron, etc. Three lines carry oil in bulk below Baton Rouge.

It is frequently averred that the reason for the falling-off in boat lines is that there has not been sufficient enterprise in the boat business. However, the keenest officials of the boat lines which have abandoned the river state that capital cannot be obtained for a business which will not pay dividends. It is their opinion that there will never be a very large river business again, and they state that personally they would not invest in projected boat companies.

IV. INTERCHANGEABILITY OF RIVER, LAKE, AND OCEAN VESSELS

It is assumed by many that the Lakes-to-the-Gulf Deep Waterway, with a channel depth of 14 feet, as proposed, would be navigable for ocean and lake vessels, and that transshipment would not be necessary at either New Orleans or Chicago. Others think that if a channel of a depth from 20 to 30 feet were constructed, ocean vessels would certainly come to Chicago. Even prominent men of experience in engineering and in transportation have expressed the opinion that ocean vessels may be brought to Chicago, and that this should be done. Such views are heard from the rostrum, through the press, and before Congressional committees.

Mr. Lyman E. Cooley, a civil engineer of note, spoke as follows before a Committee of the Senate of the United States:

> You cannot hope to develop this great interior of the Continent (the greater Mississippi Valley), 10 units as great as France or Germany, without giving them a waterway system. You cannot take them to the sea, but you can bring the sea to their doors, give each unit area a virtual sea front, from which can be expanded arms and laterals and the details of a complete and related waterway system.[1]

Even Mr. Theodore P. Shonts, a distinguished civil engineer and railroad president, not long since gave public utterance to the same opinion. In speaking of the benefits to be derived on the

[1] Statements of Mr. Lyman E. Cooley before the Committee on Commerce of the Senate of the United States, February, 1910, p. 38.

completion of the Panama Canal and the Deep Waterway, he said: "Ships will be able to load in Chicago, St. Louis, New Orleans, or intermediate points and deliver the cargo along both coasts of Central and South America without breaking bulk."[1]

With the views expressed above it seems well to compare those of the Commissioner of Corporations of the United States, Mr. Herbert Knox Smith.[2] He says:

> Large ocean-going vessels are not suited for the restricted channels of rivers and canals. Even on the Hudson River practically no ocean steamers are seen at any distance above New York, although there is 25 feet of water as far as Hudson, 100 miles from the mouth of the river. On the Mississippi River even light-draft ocean screw steamers cannot be used to advantage at any considerable distance above New Orleans. Sailing vessels cannot use the narrow, winding channels of rivers. At the same time vessels used on rivers and canals are not strong enough nor usually built with sufficient free board to equip them to be used on open-water routes, such as the lakes or the ocean. The flat-bottom stern-wheel Mississippi steamer is entirely unsuited to conditions on the sea or on the Great Lakes; and the comparatively small barges used on rivers are distinctly different in type from the large schooner barges used in the deep-sea coast traffic, and neither of these types is well adapted to the routes of the other. Even Great Lakes vessels are not in model or structural strength adapted to ocean conditions, and some experts hold that were there a channel deep enough for them to reach tide-water it would still be usually necessary to transship from lake to ocean vessels. . . .
>
> It cannot be expected that any reasonable expenditure on our inland waterways will wholly remove these difficulties. The expense of securing channels of sufficient depth on rivers and canals for ocean or the larger Great Lakes steamers would, except in a few cases, be prohibitive, if at all possible; while if a sufficient depth were secured other conditions would prevent their use by ocean-going vessels to any appreciable extent. . . .
>
> Water-borne traffic will continue to be carried, for the most part, in vessels adapted to particular classes of waterways and the special traffic of such waterways. Through traffic moving from one kind of waterway to another will require transshipment. Even on long inland hauls transshipment will often be necessary.[3]

[1] Address of Mr. Shonts before the Deep Waterway Association, October 9, 1908, p. 2, Lakes-to-the-Gulf Deep Waterway Association.

[2] Mr. Smith is now completing a series of four volumes on *Transportation by Water in the United States*.

[3] *Transportation by Water*, Part I, pp. 151–52, Department of Commerce and Labor.

From these excerpts it is evident that Mr. Smith believes it impracticable to use ocean or lake vessels on rivers, or to employ river craft on either the ocean or the Great Lakes.

Inasmuch as many think, however, that the lake vessels would be employed on the proposed waterway, it is necessary to set forth some of the facts concerning the vessels and the methods employed in handling them in river channels.

The Special Board of 1909 considered the possibility of lake vessels using the proposed 14-foot channel. The report of that board states that of the freight tonnage which passed through the canals at the Sault Ste. Marie in 1907, 1.3 per cent was borne in vessels of a registered draft of 14 feet or less, 18 per cent, of a draft of from 14 to 19 feet, 24 per cent, of a draft of from 19 to 21 feet, and 56.7 per cent, of a draft of more than 21 feet.[1] That is, 56.7 per cent of the tonnage of the canals at the Sault Ste. Marie could not have entered the Chicago River with its 21 feet of depth, provided the vessels had been loaded to their full capacity; and only 1.3 per cent could have been borne in a 14-foot channel.

It is also stated in the above report that the lake freighters built since 1902 "could barely carry the necessary fuel supply required" for a trip from Chicago to New Orleans on a 14-foot channel; that a lake freighter is poorly constructed for navigating a tortuous river and a swift current; that the rudder power is insufficient to control such great length; and that the lake vessels are less economical than barge tows as a means of transporting freight on rivers and canals.[2]

Col. C. McD. Townsend, who is in charge of the improvement of the harbors of the Great Lakes, in discussing the Chicago Harbor problem before the Western Society of Engineers, in 1910, said:

When the majority of the wharves and ships were constructed on the Chicago River, there were few if any vessels on the Great Lakes over 200 feet in length, and 12 feet draft; but the construction of the locks at Sault Ste. Marie and the deepening of the channels connecting the Great Lakes have created a revolution in vessel construction. In 1890 a vessel was built 310

[1] H. Doc. 50, 61st Cong., 1st sess., p. 23.

[2] *Ibid.*, p. 24.

feet in length, by 1895 the length had increased to 380 feet, by 1900 to 474 feet, by 1905 to 569 feet, by 1906 to over 600 feet; . . . . and at the present time there are built and contracted for 19 vessels 600 feet in length, capable of carrying a cargo of 12,000 tons each.

In 1895 the freight passing the "Soo" was all in vessels less than 400 feet in length; in 1903, 40 per cent of the freight was carried in vessels exceeding that length, and in 1908, 74 per cent, ... 45 per cent being in vessels over 500 feet long. This has resulted not only from the building of large vessels, but also from the withdrawal of the smaller from trade. . . . . In 1895 the average ore cargo was 1,800 tons, in 1908 over 8,000 tons.

A vessel 200 feet long had comparatively little difficulty in navigating the Chicago River, even in a moderate current; but when three-fourths of the commerce of the lakes is in vessels exceeding 400 feet in length, it is another story. With a discharge of 10,000 cubic feet in the Chicago River, it will be a physical impossibility for a modern lake freighter to proceed from the mouth of the river to the Chicago Drainage Canal, or to enter any of the numerous slips in its vicinity. In my opinion, the widening and deepening of the Chicago River to more than 16 feet above the Forks (1.58 miles from the lake) for purposes of navigation is a waste of public funds. If Chicago River is ever to regain its commercial importance, it will have to be by a system of wharves near the river mouth. . . . .

If we assume that a ship canal through Chicago would develop the freight that existed at the Soo in 1895 . . . . there would be required to carry that freight 16,793 vessels during a season of navigation, or one vessel would pass through Chicago, on an average, every 20 minutes. What would happen to the enormous land traffic across its 26 bridges under such conditions?[1]

Col. Townsend does not mention the draft of the lake vessel, but the vessel more than 400 feet over all commonly draws from 18 to 22 feet, and hence could not navigate a 14-foot channel. He calls attention to the difficulty of handling a vessel even in the present current in the Chicago River, and mentions 200 feet as the length that can be easily handled. It was learned from the harbor master that on account of the curves and the current 400 feet would be the extreme length that could pass the first bridge; while the bulk of the traffic entering the Calumet Port, in South Chicago, is now borne by vessels from 500 to 600 feet in length. The vessels now entering the Chicago River are rarely more than 350 feet in length over all. They do not come in on their own power, but are towed in and out at a speed of from 1 to 2 miles an hour. This is

[1] *Journal of Western Society of Engineers*, XV (April, 1910), 160–62.

true of the larger vessels even in the Main River where the channel is from 200 to 300 feet in width except at the bridges. The not infrequent accidents caused by vessels crashing into bridge piers, as well as the high cost of towage and the expense due to delay, have caused the lake fleets to use the wharves near the mouth of the river.

This difficulty is encountered while there is a flow through the river channel of only 7,000 cubic feet per second. What the difficulties will be when the flow is increased to 10,000, 14,000, or 20,000 cubic feet per second to meet the demands of the increase in the amount of sewage, and when lake vessels from 600 to 800 feet in length are used, is not easy to predict. Though the Calumet River is much straighter than the Chicago River and the velocity of the current is not so great, most vessels are towed in, and almost all are towed out, at a speed of less than two miles an hour. The time it would require, and the expense it would involve, to tow these vessels through a channel of 36 miles, the distance from Chicago to Lockport would prohibit their use.

These difficulties are met even where there is sufficient depth and where the velocity of the current is only from one to two miles an hour (in the Calumet River). Where only 14 feet should obtain as proposed for the Lakes-to-the-Gulf Deep Waterway, and where the velocity of the current should be from two to four times as great as it is in the Chicago and Calumet rivers, it would seem hardly possible to use any of the important lake or ocean vessels. But even if lake vessels could be handled slowly through a river channel, the loss of time in addition to towage charges and river insurance on both cargo and hull would make it unprofitable to employ lake vessels extensively on either canals or rivers.[1]

To summarize: (1) the engineers found that the important traffic of the Chicago Harbor could not be carried through a 14-foot channel; (2) the size of the lake vessels has so increased since 1901 that the large freighters cannot now enter the Chicago River even when steered by a tow; (3) no vessel of importance can pass through

[1] The charge for towing a vessel of 200 feet or over from the Lake to the mouth of the Sanitary Canal (six miles) and return is $150.00. River insurance will be considered in a second article.

the South Branch of the Chicago River without a tow; (4) when the velocity of the current shall be increased, the difficulties of navigation will be heightened; and (5) were it possible to tow the large lake freighters through a channel as long as that of the Chicago River and Drainage Canal, the expense of towage, of hull and cargo insurance, would make it unprofitable.

It is sometimes assumed that if lake vessels could not navigate the Lakes-to-the-Gulf Waterway, the river vessels at least could ply on the lakes. The river vessels might pass through the canals and the lakes to Buffalo, it is thought, saving transshipment.

Concerning barge traffic the following dimensions may be compared with those of the Drainage Canal and the Chicago River. The barge fleets that plied between St. Louis and New Orleans from the eighties to 1903 were commonly towed with two and three barges abreast, the tow having a width of 108 feet and a length of 900 feet. The model barges were 36 feet in beam. There is width for only one of these in the Chicago River and Drainage Canal. The "Steamer Sprague" and her tow of coal boats on the Ohio and Mississippi rivers sometimes has a width of 312 feet and a length of 1,132 feet.[1] These dimensions show the limitations of the use of barge lines in canals and narrow rivers. The large cargo of a river fleet of barges cannot be borne through such a channel as the Chicago River.

Concerning the use of river craft on the lakes, it is to be remembered that a rough sea is not only obstructive to such navigation; it is prohibitive. The successive waves of even a light gale would sink a river steamer.

Having noted some of the difficulties that lake vessels would meet in attempting to navigate the Chicago River and the Drainage Canal, and having seen the limitations of river craft on open waters, it is necessary to study finally the possibilities of using ocean and Gulf vessels on the proposed water route.

The draft of the ocean and Gulf vessels may be indicated by the following record. For the month of March, 1910, the arrivals and

[1] H. Doc. 492, 60th Cong., 1st sess., pp. 18–19.

departures of the port of New Orleans numbered 207. The least actual draft was 11 feet, the greatest 28 feet. The number of vessels that drew 11 feet and less than 14 was 72; the number that drew 14 feet and less than 20, was 70; the number that drew 20 feet and less than 24 feet, was 52; the number that drew from 25 to 28 feet was 13.[1] Many of these vessels of lighter draft are unimportant craft that ply only to near-by Gulf ports. Even of tramp steamers on the Atlantic few draw less than 19 feet, and of course the larger tramps and the regular liners draw from 25 to 35 feet. Some of the world's largest steamers draw more than 35 feet.

Many of the vessels that enter the port of New Orleans could navigate the present channel of the Mississippi River for at least 300 miles. There is now and has been since 1901 a channel 30 feet in depth from the head of the passes to Red River Landing, a distance of 320 miles. Also during from five to eight months in the year there is a channel 14 feet in depth from the mouth of the Red River to Cairo.[2] In other words, there is a channel for 245 miles above New Orleans deep enough and wide enough to accommodate all of the ocean vessels that cleared at that port during March, 1910. And yet none of these vessels go up the river. There is also depth enough to allow 72 of the 207 ocean vessels to visit Memphis or Cairo for five months in the year.

Why ocean vessels do not navigate the part of the Mississippi that has sufficient depth is not difficult to understand. The business man would sum it up by saying, "It will not pay." Only a few of the more obvious difficulties need be set forth.

The Special Board of 1909, in its report, makes the following statement:

> Large, deep-draft, heavily loaded boats are unwieldly, especially when trying to back against the current; and when coming downstream such boats cannot be handled safely except in wide, deep channels, such as are far greater than can ever be expected in the Mississippi River above the mouth of Red River. While an ocean steamer might safely go slowly up the Mississippi against the current with a draft somewhat less than the channel depth over

[1] From a list prepared and sent to the writer by Mr. Tiley S. McChesney, assistant secretary and treasurer, Board of Commissioners, port of New Orleans.

[2] H. Doc. 50, 61st Cong., 1st sess., p. 336.

its bars, it is very doubtful whether it could ever get down the river with safety except during high freshets when all bars were deeply submerged.[1]

It is more economical for large ships to unload their entire cargo at one port than at several. The daily expense of one of these vessels is so great that they must avoid delays in loading and unloading whenever possible. Moreover port facilities on the Mississippi for ocean vessels could be constructed only at prohibitive costs.[2]

The imports at New Orleans are sent to a wide area ranging from points in Florida and Georgia to points in the northwestern and western parts of the United States. If this freight were carried by ocean vessels to St. Louis or Chicago, much of it would be reshipped, and the saving in freight charges would not be sufficient to compensate ocean vessels for the inland trip. Similar conditions exist concerning exports. The difference in the cost of collecting freight at St. Louis, for example, and the cost of collecting it at New Orleans would not be sufficient to pay river charges from St. Louis to New Orleans.

If there were no other reason why ocean vessels would not use the improved Mississippi, the very cost of navigation on a long treacherous channel by a seaworthy vessel would be prohibitive in competition with American railway rates, or with barge rates. The average cost of constructing an ocean vessel is $71 for each ton of freight carried. For lake vessels the cost is only $41.50, and for a Mississippi River steamboat and 10 barges carrying 10,000 tons of freight the cost is only $12 per ton of freight carried.[3]

Moreover, the lower speed of ocean vessels on inland channels increases the cost. If an ocean vessel could make six miles an hour on a trip from New Orleans to St. Louis, against the current, four miles an hour through the three canals and six locks past some thirty drawbridges from St. Louis to Joliet, and three miles an hour through the Drainage Canal and Chicago River past forty-one drawbridges from Joliet to Chicago; if this speed could be

[1] H. Doc. 50, 61st Cong., 1st sess., p. 336.

[2] See above, Section II.

[3] H. Doc. 50, 61st Cong., 1st sess., p. 24.

made with no stop for coaling, unloading, or fogs, the time required to make a round trip between New Orleans and Chicago would be more than twenty-four days.

It is sometimes said that the United States needs a deep waterway from the Gulf to the lakes through which to send battleships to meet the English navy on the lakes, in the event of war with Great Britain. Senator William Lorimer recently said:

> Great Britain has the St. Lawrence River that she can pass half her navy through. Coming through the St. Lawrence, they have fourteen-foot locks at all their falls. When war is rumored, and war is always rumored before it is declared, they can harbor half of their fleet on the St. Lawrence River, and, in twenty-four hours cross Lake Ontario. Here they have the Welland Canal, and in less than a week they can place that fleet upon the Great Lakes, and threaten, and destroy if they please, the commerce of these lakes; the commerce of the Great Lakes is the greatest commerce upon the face of the earth.[1]

It would hardly seem necessary to call Mr. Lorimer's attention to the fact that modern battleships cannot navigate channels fourteen feet in depth, but as an example of how unwittingly people speak concerning the Lakes-to-the-Gulf Deep Waterway a quotation from Mr. Truman H. Newberry, secretary of the navy of the United States, may be given. He recently wrote:

> Taking the "Vermont" as a typical modern battleship, it is possible, but would be exceedingly difficult and expensive, to reduce the draft by removing all of the movable weights on board, the secondary and auxiliary batteries, coal, etc., to about 21—6, mean draft. In removing these weights, however, the tendency of the ship would be by the stern, the amount of which could be determined by exact calculations, but roughly 23′ would be considered a reasonable minimum.[2]

It may be added that this statement had reference to salt water, and that a draft of more than 23 feet would be required in fresh water. From this it is seen that the navy of the United States could not be floated on a 14-foot channel.

Mr. Robert Isham Randolph, secretary of the Internal Improvement Association of Illinois, in a recent address before the General

[1] Address before the Committee of the Whole in the House of the Forty-sixth General Assembly of Illinois, May 6, 1909.

[2] From a letter to Mr. Robert Isham Randolph.

Assembly of Illinois, said in regard to the English navy entering the Great Lakes through the St. Lawrence System:

> *Brassey's Naval Annual* for 1908 gives a list of the ships in the British navy. Of these not one single armored ship is small enough to get through these locks. The only ships in the entire British navy whose dimensions are small enough to admit of passage through these locks are torpedo gunboats, twelve in number, and the heaviest fighting equipment carried by any of them consists of two 4.7-inch guns and five six pounders.

These statements show the impossibility of sending either the navy of the United States or that of England to the Great Lakes via a 14-foot channel. Moreover, if the English fleet should ever head for the Great Lakes through an improved channel, it would require only a short time to place land artillery at some vulnerable point to sink England's proud fleet. England, of course, would not risk her navy in the Welland Canal (were it improved) during a war with the United States.

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